The Effect of a Needle Exchange Program on Numbers of Discarded Needles: A 2-Year Follow-Up

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ABSTRACT

Objectives. This study estimates the quantity and geographic distribution of discarded needles on the streets of Baltimore, Md, during the 2 years after a needle exchange program opened.

Methods. Thirty-two city blocks were randomly sampled. Counts were taken of the number of syringes, drug vials, and bottles before the needle exchange program opened and then at 6 periodic intervals for 2 years after the program opened. Nonparametric and generalized estimating equation models were used to examine change over time.

Results. Two years after the needle exchange program opened, there was a significant decline in the overall quantity of discarded needles relative to that of drug vials and bottles (background trash). The block mean of number of needles per 100 trash items was 2.42 before the program opened and 1.30 2 years later (mean within-block change=−0.028, $P<.05$). There was no difference in the number of discarded needles by distance from the program site.

Conclusions. These data suggest that this needle exchange program did not increase the number or distribution of discarded needles. (*Am J Public Health.* 2000;90:936–939)

In the 1990s, the US National Institutes of Health recommended that state and local governments establish needle exchange programs to prevent HIV infection among injection drug users.[1–3] Concern has been expressed that needle exchange programs, which provide injection drug users with sterile replacements for their used needles and syringes, might contribute to an increase in the quantity of discarded needles found in public locations, thus posing a risk of needle stick injury to community members and sanitation workers.[4,5] In 1998, complaints of discarded needles led to the closure of the needle exchange program in Windham, Conn.[6] Because public health policy and practice guidelines are affected by these concerns, it is becoming increasingly important to incorporate systematic data collection and research into the dialogue surrounding discarded needles and needle exchange programs.

Findings from the few existing studies regarding discarded needles[7–9] have found that after a needle exchange program opens in a community, the number of observed needles discarded in the street does not increase, and might actually decline. These studies were limited by short follow-up periods, during which the volume of needles was still small and the enthusiasm of participants would be expected to be high. Earlier, we published a methodology for executing a community-based survey of discarded needles and syringes with a 60-day follow-up period.[7] Here, using the same standardized methodology, we present the results of a 2-year follow-up survey.

Theoretically, needle exchange programs with a one-for-one exchange policy should not result in an overall increase in the number of needles in the community, since the number of syringes dispensed is equal to the number removed from circulation. However, many exchange programs provide first-time exchangers with a one-time, limited supply of "starter" needles (i.e., without reciprocity), which might contribute to an increase. Conversely, it is also possible that this initial increase might be offset by the incentive to pick up needles found on streets or other public venues and exchange them at a needle exchange program site.

In 1994, the Baltimore City Health Department established a needle exchange program, operated out of 2 mobile vans making stops at 4 fixed sites. The program established an exchange policy that allowed clients 2 "starter" needles during the initial visit; for all subsequent visits, exchanges were exclusively one-for-one. As of August 12, 1996 (2 years after the needle exchange program began), 4756 injection drug users had been enrolled, 603 968 needles had been distributed, and 252 293 needles had been removed from circulation. The purpose of this study was to determine if a needle exchange program would contribute to an increase in the number and geographic distribution of discarded needles.

Methods

The methods employed to conduct this survey have been described in detail elsewhere.[7] Briefly, for a random sample of 32 city blocks in high-drug-use neighborhoods, serial counts of syringes were taken before the needle exchange program began and then at 6 periodic intervals for 2 years

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after it opened. Sixteen blocks each were selected for the survey from the east and the west sides of the city. Fourteen blocks were located less than 0.5 mile from the program site and 18 blocks were located 0.5 mile or more from the program site. Drug vials and glass bottles (background trash) were also counted to control for observer practice effects and seasonal environment changes over time. Counts were performed by a research team according to a standardized protocol; survey teams visited the blocks on a Saturday and the following Wednesday 1, 2, 7, 12, 19, and 24 months after the needle exchange program opened. This report updates previously published short-term (months 1 and 2) follow-up data.[7]

Statistical Analysis

Outcomes measured for each block surveyed included (1) the number of needles (N), (2) the number of program needles (PN), and (3) the number of vials (V) and bottles (B), collapsed into the sum of vials plus bottles (V+B). From these was computed the ratio N/(V + B), taken on the log scale (to reduce skewness) and presented as the adjusted value of N/100(V+B). This ratio provides an estimate of how the needle count varied in relation to the vial and bottle counts. Because the paired Saturday and Wednesday counts were highly correlated (results are presented in detail elsewhere[7]), these counts were averaged to give 1 set of average counts before the needle exchange program opened and 6 average counts after the program opened. These data points thus represent 2 survey days (1 Saturday and 1 Wednesday) prior to and 12 survey days after the opening of the program. Simple comparisons of counts for before and after the program were performed with paired *t* tests and nonparametric methods.

Generalized estimating equation (GEE) regression models[10,11] with the Poisson mean and variance structure were fitted to the data to explore trends before and after the needle exchange program opened while controlling for additional covariates and accounting for within-block correlation over time. To compare the relationship between needles and background trash, we modeled both the needles (N) and trash items (V+B) as outcomes in the same model. This was accomplished by treating needles and background trash as 2 separate observations in the same model and including an indicator term for needles vs vials plus bottles in the model. Covariates included the 6 survey points, indicators for distance from the needle exchange program, and east vs west sides of the city. The baseline reference groups for the model are vials plus bottles, time before the program opened, distance of 0.5 mile or more from the program, and the east side. Therefore, the coefficient at baseline for the difference between needles and vials plus bottles (0.03) is interpreted as the log needles-to-trash ratio at baseline (3 needles counted per 100 trash items).

Results

Table 1 outlines the crude outcomes measured over time. At 1 year (post4) and 2 years (post6) after the opening of the needle exchange program, the number of needles had decreased compared with the baseline count (pre). A greater number of needles was recorded at 1, 2, 7, and 19 months (post1, post2, post3, and post5, respectively). However, very few program needles were counted among the discarded syringes. The number of needles counted near and far from the program site varied by survey day, and no consistent pattern emerged. More needles were counted on the west side than on the east side; this relationship did not change over time.

Data from before and after the needle exchange program began (Table 2) show the mean within-block change and 95% confidence interval surrounding the mean for both needle counts and the number of needles per 100 trash items [N/100 (V+B)]. At no interval does the needle-to-trash ratio significantly increase. There was an initial statistically significant increase in needle count alone 7 months (post3) after the needle exchange program opened (mean within-block change = 0.30; 95% confidence interval [CI] = 0.12, 0.48). However, when trash items were controlled for, this increase was not statistically significant (mean within-block change = 0.005; 95% CI = −0.005, 0.015). One year (post4) and 2 years (post6) after the start of the needle exchange program, there were significant downward trends in needle counts (mean within-block change = −0.83, 95% CI = −1.43, –0.24; and –0.98, 95% CI = −1.46, −0.93, respectively). Similar trends were observed in the needle-to-trash ratio; there was a significant downward trend in N/100(V+B) at 2 years after the program opened (mean within-block change = –0.028; 95% CI = –0.044, –0.011).

Table 3 presents the rate ratio estimates from the GEE regression model; results were similar to those presented in Table 2. For example, the model coefficients listed in the footnotes should be interpreted as follows: the first column coefficient of 1.03 repre-

TABLE 1—Total and Block Mean Counts of Surveyed Items for 32 City Blocks Over 2 Years: Baltimore, Md, 1994–1996

Survey Data	Pre-NEP[a]	Post1[a]	Post2[a]	Post3[a]	Post4[a]	Post5[a]	Post6[a]
Needles	53.0[b]	65.0	59.0	62.5	26.5	68.0	21.5
Distribution of needles							
<0.5 mi from NEP site	30.0	25.5	22.5	36.0	11.0	19.0	14.5
≥0.5 mi from NEP site	23.0	39.5	36.5	26.5	15.5	49.0	7.0
East side of city	13.5	22.5	18.0	23.0	8.0	17.0	4.0
West side of city	39.5	42.5	41.0	39.5	22.5	51.0	17.0
Program needles	-	2.0	1.5	8.0	0.5	6.0	3.5
Vials	222.5	231.0	204.5	238.0	149.0	664.5	201.5
Bottles	1301.5	1681.5	1693.5	1334.5	1272.5	1897.5	948.5
Block Mean: (N/100(V+B))[c]	2.42	2.45	2.03	3.01	1.32	2.26	1.30

Note. N = needles; NEP = needle exchange program; PN = program needles; V = vials; B = bottles.
[a]Labels refer to the averaged data collected on specific survey dates: pre-NEP = August 6 and 10, 1994; post1 = September 10 and 14, 1994; post2 = October 8 and 12, 1994; post3 = March 11 and 15, 1995; post4 = August 5 and 9, 1995; post5 = March 16 and 20, 1996; post6 = August 10 and 14, 1996.
[b]Average values of correlated data from 2 survey days were taken to provide a more stable measure of the counts for each period.
[c]exp {mean of log[N/(V+B)]} × 100 = block mean ratio of needles to vials + bottles averaged over 32 blocks. Averages were taken on the log scale to reduce skewness, exponentiated, and presented as needles per 100 trash items.

TABLE 2—Change in Mean Needle Count per Block and Mean Ratio of Needles per 100 Vials and Bottles per Block Relative to Pre–Needle Exchange Program (NEP) Surveys for 6 Time Periods After the NEP Opened: Baltimore, Md, 1994–1996

	Needle Count		N/100(V+B) Ratio[a]	
Comparison Interval From Pre-NEP[b]	Mean Within-Block Change[c]	95% CI[d]	Mean Within-Block Change[c]	95% CI[d]
Post1 (month 1)	0.38	–0.15, 0.91	0.0003	–0.025, 0.026
Post2 (month 2)	0.19	–0.69, 1.07	0.005	–0.025, 0.036
Post3 (month 7)	0.30	0.12, 0.48*	0.005	–0.005, 0.015
Post4 (month 12)	–0.83	–1.43, –0.24*	–0.017	–0.036, 0.003
Post5 (month 19)	0.47	–0.66, 1.60	0.003	–0.033, 0.038
Post6 (month 24)	–0.98	–1.46, –0.93*	–0.028	–0.044, –0.011*

[a]N/100(V+B) = number of needles per 100 vials and bottles expressed as a ratio; needle count is adjusted for background trash.
[b]Average values of correlated data from 2 survey days were taken to provide a more stable measure of the counts for each period. Labels refer to the averaged data collected on the specific survey dates: pre-NEP = August 6 and 10, 1994; post1 = September 10 and 14, 1994; post2 = October 8 and 12, 1994; post3 = March 11 and 15, 1995; post4 = August 5 and 9, 1995; post5 = March 16 and 20, 1996; post6 = August 10 and 14, 1996.
[c]Mean within-block change = change in needle counts and N/100(V + B) averaged over 32 blocks for the separate time periods.
[d]95% confidence intervals around the mean change calculated from the SE of the mean and 2-tailed probability of the *t* distribution.
*$P < .05$.

sents the average per-block needle count at baseline (pre-NEP, ≥0.5 mile from the NEP, on the east side of the city), 38.31 is the average per-block V+B count, and 0.03 is the log needles-to-trash ratio at baseline. The first column shows the needle count rate ratio (rate of needle count compared with a baseline of 1). The needle count increased up to 7 months after the program opened (post3), but it did so in step with increases in the vial-plus-bottle count, as noted in the second column. One and 2 years later (post4 and post6), the needle count significantly declined (rate ratio [RR] = 0.49; 95% CI = 0.35, 0.74; and RR = 0.41; 95% CI = 0.28, 0.59, respectively). More specific interpretations can be made from the interaction of the time variable and the needle vs background trash indicator variable (presented as a ratio of the rate ratios in the last column in Table 3). The reported value is the change in needle count over time, with control for background trash. At all time points, except at 7 months after the program opened, the ratio of rate ratios of needle count to background trash did not increase. One and 2 years later, the number of needles was significantly less likely to increase relative to trash, given that the ratios of rate ratios were significantly less than unity (at 1 year, ratio of RR = 0.53; 95% CI = 0.34, 0.84; at 2 years, ratio of RR = 0.54; 95% CI = 0.37, 0.78). There were no differences by proximity to the needle exchange program. Consistent with findings reported earlier, there was a nonsignificant trend of more needles and trash items found on the west side of the city than on the east side (ratio of RR = 1.26; 95% CI = 0.65, 2.46).

Discussion

The major finding of this study was that the establishment of a needle exchange program in Baltimore was not associated with an increase in the overall quantity or geographic distribution of discarded syringes in public locations over a 2-year period. While consis-

TABLE 3—Rate of Change of Needle Count Compared With the Vial-Plus-Bottle (V + B) Count Over 32 City Blocks Based on GEE Regression: Baltimore, Md, 1994–1996

	Needle Count		V + B Count		Ratio of Change Between Needle and V + B Counts	
Covariates	RR[a]	95% CI[b]	RR[a]	95% CI[b]	Ratio of RRs	95% CI[b]
Post1 (month 1)[c]	1.23	0.91, 1.66	1.26	1.01, 1.56*	0.98	0.66, 1.45
Post2 (month 2)[c]	1.11	0.68, 1.83	1.56	0.99, 1.56	0.89	0.51, 1.56
Post3 (month 7)[c]	1.18	1.05, 1.33*	1.01	0.99, 1.02	1.17	1.04, 1.33*
Post4 (month 12)[c]	0.49	0.35, 0.74*	0.94	0.76, 1.15	0.53	0.34, 0.84*
Post5 (month 19)[c]	1.28	0.72, 2.29	1.68	1.37, 2.08*	0.76	0.40, 1.46
Post6 (month 24)[c]	0.41	0.28, 0.59*	0.76	0.61, 0.94	0.54	0.37, 0.78*
Distance < 0.5 mi[d]	0.86	0.44, 1.63	0.72	0.44, 1.18	1.20	0.50, 2.90
West side of city[e]	2.49	1.37, 4.55*	1.98	1.27, 3.08*	1.26	0.65, 2.46

Note. GEE = generalized estimating equation; RR = rate ratio; CI = confidence interval; NEP = needle exchange program.
[a]Reference rates expressed as model coefficients: needle rate per block at baseline is 1.03; 95% CI = 0.51, 2.09; rate of V + B per block at baseline is 38.31; 95% CI = 26.70, 54.90; ratio of rates for needles relative to trash items is 0.03; 95% CI = 0.01, 0.06.
[b]95% CI based on the GEE robust estimates of the SE.
[c]Reference category: pre-NEP.
[d]Reference category: distance from NEP ≥ 0.5 mi.
[e]Reference category: east side of city.
*$P < .05$.

tent with earlier reports,[7–9] this study is the first to report surveillance data for an extended follow-up period of 2 years. Whether the decrease in needles observed was due to an increase in needles returned to the needle exchange program, an independent change in patterns of discarding needles (from the street to other public locations), or some other factor cannot be determined with certainty from these data. However, we did observe seasonal fluctuations in needle and trash counts that appeared to occur irrespective of the needle exchange program, as evidenced by the consistently higher counts of all items (needles and syringes, drug vials and bottles) during winter and early spring months. The increased counts noted for early spring might be related to drug traffic, drug use practices, or lack of the vegetation that could have obscured items during the summer and fall surveys. Other unmeasured factors, such as police activity, change in drug users' perception of the needle exchange program, and secondary exchange, may have influenced the number of needles returned to the program and the number of needles discarded in the street. The downward trend may also be related to the economics of needle availability. Among injection drug users, needles and syringes are valuable and, at times, difficult to obtain. Injection drug users may scavenge discarded needles on the streets for exchange at the program sites, and this, in turn, may decrease the number of needles found in the community.

Although the downward trends in needle counts 1 and 2 years after the start of the needle exchange program could have been influenced by an a potential observer effect, the similar trends for needle and control items minimize the risk of such an effect, if it existed. There are certain limitations, however, to our needle–to–background trash ratio. Used as an index of relative change over time, this ratio has not been validated and may not be applicable to other environments and communities. However, it proved practical for our survey since the trends in both discarded needles and trash mirrored each other over time, indicating that the change in needles was not related to the survey methods but more likely was due to environmental or unmeasured influences on discarded needles.

One could speculate that had the survey continued for another 6 months, the needle count might have increased compared with the downward trends recorded in the summer months. However, it is unlikely that the counts would be greater than those recorded prior to the start of the needle exchange program. This is encouraging, given that the program continued to function during the period of study and distributed approximately 620 000 needles and syringes without causing a significant increase in discarded needles. Had there been a true increase in discarded needles due to the needle exchange program, the increase would have likely occurred near the program sites. However, this study found neither an increase in the number of needles nor a difference in needle distribution by proximity to the program sites. Nonetheless, these findings are specific to the Baltimore needle exchange program, which functioned primarily on a one-to-one exchange basis, and may not be generalized to other programs with different distribution-to-exchange ratios.

These findings are important for state and local organizations considering the implementation of needle exchange programs, because there are multiple sources of variation in needle counts. Systematic surveys such as the one performed here are useful for identifying long-term trends. In Baltimore, there is evidence that the needle exchange program did not increase the burden of discarded needles in the community and therefore could not have elevated the risk of accidental needle sticks with potentially infectious needles. These systematic data are in contrast to reports from Windham, Conn, where sporadic complaints of discarded needles fueled community concerns that eventually led to the closing of the needle exchange program in that community.[6] Given the benefits of needle exchange programs in decreasing HIV rates, concerns in the community about discarded needles should be taken seriously but also subjected to systematic scrutiny before programs demonstrated to have public health benefit are removed. □

Contributors

M. C. Doherty, B. Junge, R. S. Garfein, E. Riley, and D. Vlahov contributed to the design and implementation of the study. P. Rathouz provided statistical expertise and assisted M. Doherty with data analysis. All of the authors contributed to drafting and editing the paper.

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